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PROJECT BOOKLET

MAT2038 Applied Mathematics 20
Module 4

FOR STUDENT USE ONLY	
Date Assignment Submitted: _____	(If label is missing or incorrect)
Time Spent on Assignment: _____	Student File Number: _____
	Module Number: _____

FOR OFFICE USE ONLY

Assigned Teacher: _____

Assignment Grading: _____

Graded by: _____

Date Assignment Received:

Student's Questions and Comments

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Name

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Teacher's Comments

_____
Teacher

INSTRUCTIONS FOR SUBMITTING THIS DISTANCE LEARNING PROJECT BOOKLET

When you are registered for certain distance learning courses, you are expected to submit completed projects for correction. Try to submit each project as soon as you complete it. Do not submit more than one Project Booklet in one subject at the same time. Before submitting your Project Booklet, please check the following:

- Is the project completed? If not, explain why.
- Has your work been reread to ensure accuracy in spelling and details?
- Is the booklet cover filled out and the correct module label attached?

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Module
4

Applied Mathematics 20

LINEAR PROGRAMMING

PROJECT BOOKLET

Learning Technologies Branch

Alberta LEARNING

FOR TEACHER'S USE ONLY

Summary

Total Possible Marks	Your Mark
40	

Teacher's Comments

Applied Mathematics 20
Module 4: Linear Programming
Project Booklet
Learning Technologies Branch
ISBN 0-7741-1992-6

Title page: PhotoDisc, Inc.

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Students	✓
Teachers	✓
Administrators	
Home Instructors	
General Public	
Other	

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- Alberta Learning, **http://www.learning.gov.ab.ca**
- Learning Technologies Branch, **http://www.learning.gov.ab.ca/ltb**
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PROJECT BOOKLET
APPLIED MATHEMATICS 20: MODULE 4

Your mark for this module will be determined by how well you do on the module project in this Project Booklet and the module assignment in the Assignment Booklet.

The value of each part of the module project is stated in the left margin of this booklet. The total value of the module project is 40 marks.

Read all parts of this booklet carefully and record your answers in the appropriate place. Work slowly and carefully. If you are having difficulities, go back and review the appropriate activity in the Student Module Booklet.

Be sure to complete all parts of the project and proofread your responses before submitting this project to your teacher. If you require more room for any response, use your own paper and attach it securely to this booklet.

(40)

Module Project: Trail Mix

Your project for Module 4: Linear Programming is Trail Mix. This project involves modelling and optimizing a trail mix using systems of linear inequalities and graphs. You will then use your model to investigate choices involved when producing a trail mix.

1. Indicate the average recommended daily intake or other dietary recommendations for the following nutrients. Indicate how each nutrient is significant to good health.

(1) **a.** Dietary fibre

_____

_____

(1) **b.** Fat

_____

_____

(1) **c.** Protein

_____

_____

(3)

2. Indicate the amount of food energy (number of calories) a person needs each day and what factors influence a person's food energy requirements.

_____

_____

_____

_____

_____

(12)

3. Turn to page 198 of the textbook and answer exercise 2 of "Finding Feasible Snack Mixes." Refer to the chart on page 199 of the textbook as you do the exercise. (The mixtures you propose should be different from those already analysed in the Student Module Booklet and in the textbook.)

Hints:

- Avoid proposing trail mixes composed of a pair of similar ingredients, such as semisweet chocolate and milk chocolate.
- Avoid pairs of ingredients in which neither ingredient meets the 25% reduced fat condition.
- For each of three pairs of ingredients, choose the amount of each ingredient you want in the mix.
- Make sure your trail mixes indeed contain 25% less fat and 5% more fibre, carbohydrates, or protein. You may have to adjust the amounts or possibly change ingredients.

(There is more room given on the next page.)

4. Let x be the mass (in grams) of one ingredient and y be the mass (in grams) of the other ingredient making up a mixture that satisfies the conditions in exercise 3.

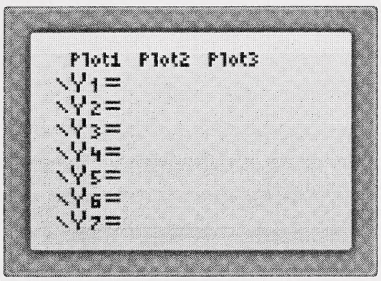
(3)

a. For each of the three pairs of ingredients you selected, write a system of linear inequalities to represent the first three bulleted conditions (constraints). Where necessary, rewrite the inequalities so y is isolated on the left side of the inequality sign.

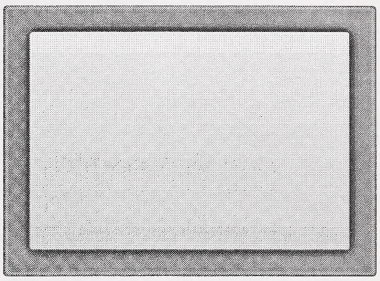
③

b. Use reverse shading to graph the solution regions for the three systems of inequalities on your graphing calculator. Sketch your graphs, labelling the axes.

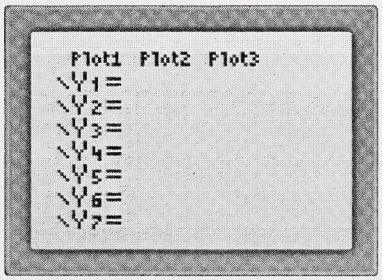
Mixture 1



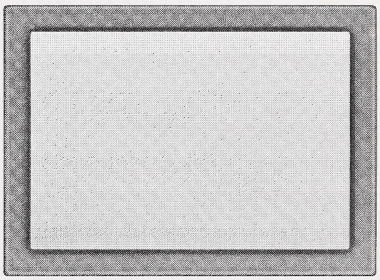
reverse shading



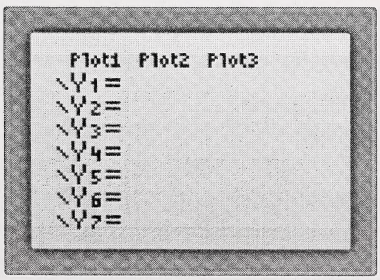
Mixture 2



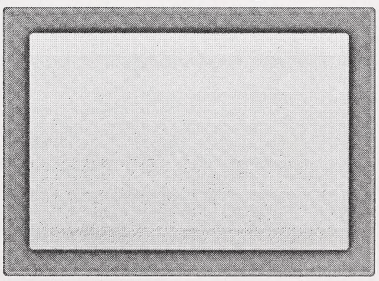
reverse shading



Mixture 3



reverse shading



(3) **c.** For each of the three pairs of ingredients, determine the objective function based on the cost of the ingredients. Refer to the table on page 210 of the textbook.

(3) **d.** For each of the three proposed mixtures, use the solution region to determine the composition of the least expensive mix.

(3) **e.** Indicate the costs of the three least-expensive mixes.

_____

_____

_____

(3) **f.** From the perspective of nutritional content, compare the three least-expensive mixes to the trail mixes you proposed in exercise 3 and indicate whether they satisfy the fourth bullet.

(4) **5.** At first you proposed three trail mixes—without regard to cost—based on three pairs of ingredients. Then you found three more trail mixes based on the same pairs of ingredients. Decide which of these trail mixes would be most suitable to produce and market. Give reasons for your choice.

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ASSIGNMENT BOOKLET

MAT2038 Applied Mathematics 20
Module 4

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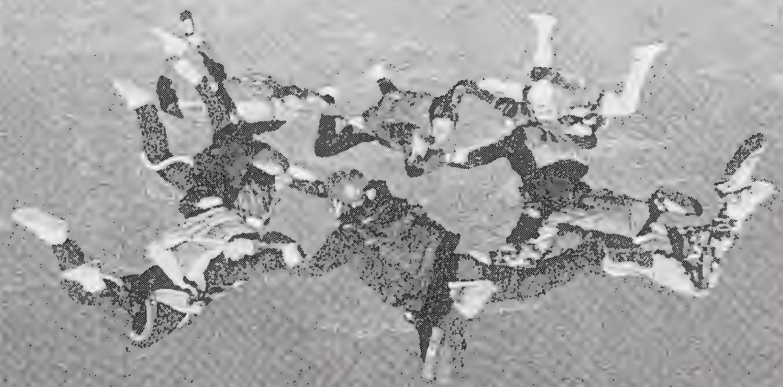
Module 4

Applied Mathematics 20

LINEAR PROGRAMMING

ASSIGNMENT BOOKLET



Learning Technologies Branch

Alberta LEARNING

FOR TEACHER'S USE ONLY

Summary

Total Possible Marks	Your Mark
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Teacher's Comments

Applied Mathematics 20
Module 4: Linear Programming
Assignment Booklet
Learning Technologies Branch
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ASSIGNMENT BOOKLET
APPLIED MATHEMATICS 20: MODULE 4

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Be sure to complete all parts of the assignment and proofread your responses before submitting this assignment to your teacher.

(60)

Module Assignment

1. A student's parents set the following condition (constraint):

> The time spent surfing the Internet and watching TV should be no more than 40% of the time spent reading and doing homework.

(2) **a.** Express this condition as a linear inequality in two variables. Indicate what each variable represents.

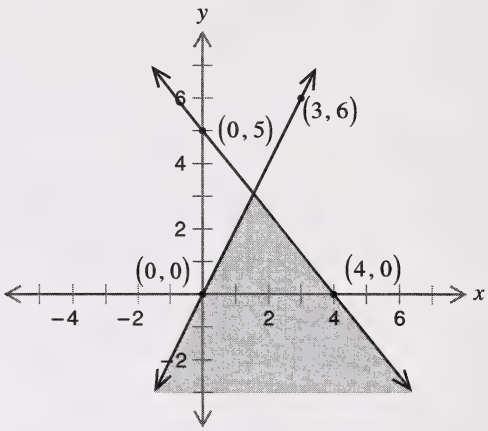
(1) **b.** In modelling this situation with a system of inequalities, there are implicit constraints. What are the implicit constraints for this situation?

_____

_____

(4)

2. A student graphed a system of inequalities, shading only the region containing the solutions of the system. Write a system of inequalities corresponding to the student's graph. Explain how you arrived at your answer.



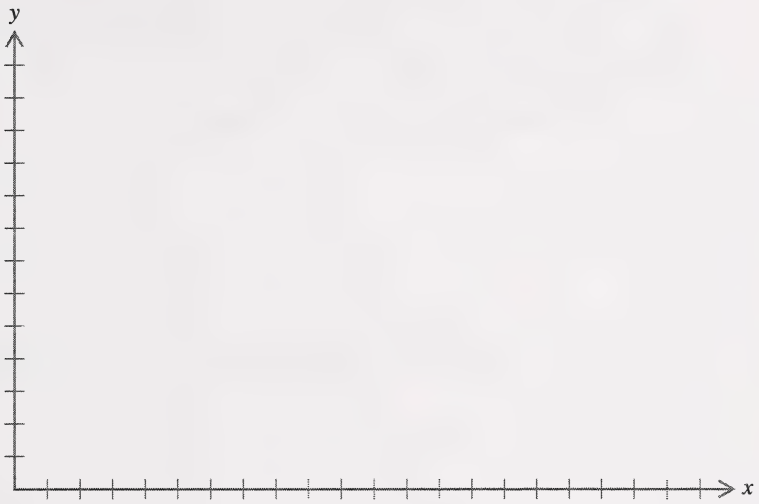
(2)

3. Russel used his graphing calculator to graph an inequality using reverse shading. Write an inequality that is represented by the graph.

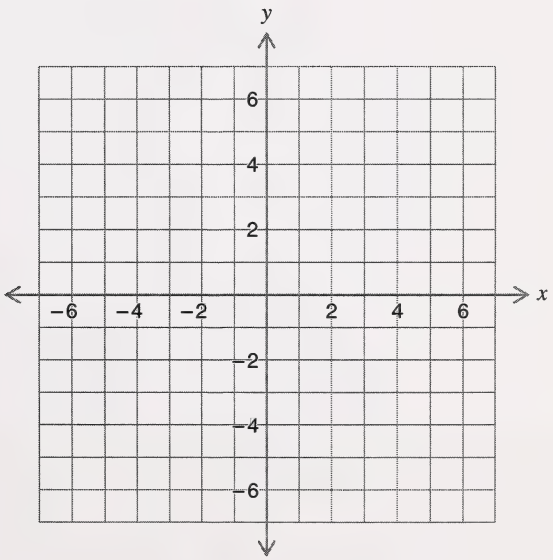
(4) **4.** Sketch the graph of the following system. Shade only the region containing the solutions.

$x \geq 8$ (1) $\quad 12x + 5y \leq 240$ (3)

$y \geq 15$ (2) $\quad 3x + y \geq 48$ (4)



(4) **5.** Graph the inequality $2x + 3y < 6$. Use regular shading (not reverse shading) to identify the appropriate region, and choose a test point to check the graph. Show your work.



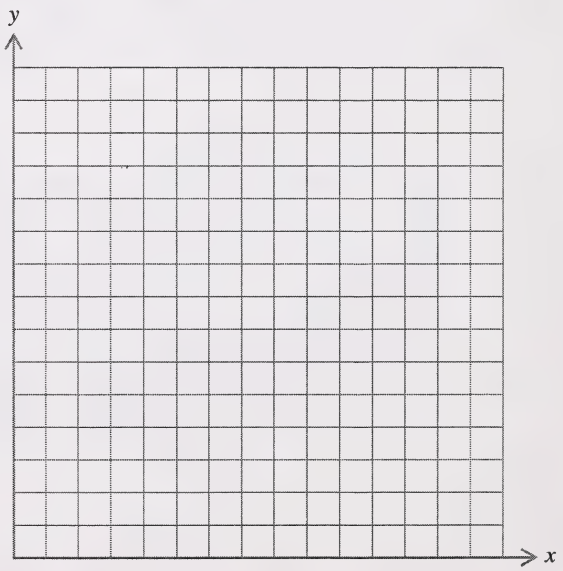
6. A wooden-toy factory makes bundles of tops and bundles of pegs. Each bundle of tops requires 20 min on the lathe and 12 min on the table saw. Each bundle of pegs requires 4.5 min on the lathe and 20 min on the table saw. A production manager wants to know how many of each can be produced in an hour or less of workshop time (meaning up to 1 h is spent on the lathe and up to 1 h is spent on the table saw).

Let x be the number of bundles of tops that can be produced and y be the number of bundles of pegs that can be produced.

(2) **a.** Write an inequality for each given constraint.

(1) **b.** Write an inequality for each implicit constraint.

(4) **c.** Graph the number of items (bundles of tops or bundles of pegs) that can be produced in 1 h. Shade only the region corresponding to the solutions.



7. Tessa, a store manager, wants to order bicycles for the coming season. She can order mountain bikes for $300 each and road bikes for $250 each. Tessa needs to order at least 5 of each but spend no more than $4500 in total. She wants to determine how many bicycles she can order of each type.

(2) **a.** Write a system of inequalities to model the problem situation.

(4) **b.** Sketch a graph of the system of inequalities, shading the region containing the solutions. Label the axes.

(2) **c.** Write two different orders Tessa could make according to the conditions (constraints) of the situation.

_____

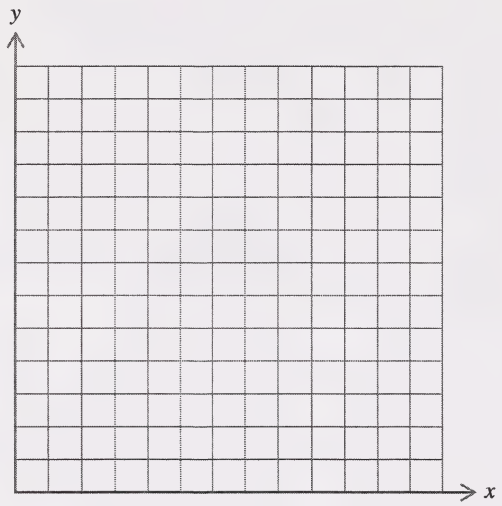
_____

(2)

8. The constraints of a situation are represented by this system of inequalities:

$x + y \geq 12$ (1)
$x \leq 10$ (2)
$y \leq 10$ (2)

Graph the system on the grid provided.



9. Using the graph in exercise 8, indicate the minimum point(s) meeting the constraints and the value at the minimum point(s) you found for each of the following objective functions. Justify your answer.

(2)

a. $Q = 6x + 3y$

(2) **b.** $R = x + 5y$

(2) **c.** $S = 3x + 3y$

(2) **10.** Explain why the vertices of a solution region are important when using linear systems of inequalities for optimization problems.

_____

_____

_____

_____

(2) **11.** Suppose only dotted lines (rather than solid lines) border a solution region. A given linear objective function, say $Q = x + y$, is based on continuous variables. Can the objective function have a maximum or a minimum value? Explain.

_____

_____

_____

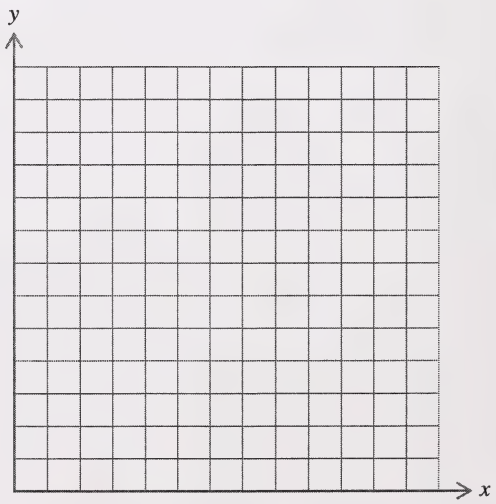
_____

_____

12. A landscape designer has to design a rectangular pad of concrete at the centre of a rock garden. The length must be less than or equal to twice the width; the perimeter must be less than or equal to 40 m; and the area must be greater than or equal to 60 m^2.

(3) **a.** Write a system of inequalities to represent the constraints in this problem situation.

(5) **b.** Graph the system of inequalities, shading only the solution region.



(8)

13. A company manufactures bicycles and tricycles. The total number of frames the company manufactures cannot exceed 80 per month. It takes the company 1 h to assemble a bicycle and 2 h to assemble a tricycle. The assembly machine is only available for 100 h each month.

If the company makes a profit of $50 on each bicycle and $70 on each tricycle, determine the number of bicycles and tricycles that will maximize profits each month. Indicate the maximum profit the company can make each month.

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